IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In the Patent Application of

Z. Jason Geng

Application No. 10/728,393

Filed: December 4, 2003

For: A System and a Method for High Speed Three-Dimensional Imaging

Group Art Unit: 2622

Examiner: PETERSON, Christopher K.

Confirmation No.: 9234

APPEAL BRIEF

Mail Stop Appeal Brief - Patents
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

This is an Appeal Brief under Rule 41.37 appealing the decision of the Primary Examiner dated **January 27, 2010** (the "Final Office Action"). Each of the topics required by Rule 41.37 is presented herewith and is labeled appropriately.

I. Real Party in Interest

The real party in interest is Genex Technologies, Inc. of Maryland. The inventor has assigned and recorded the assignment of all rights in the invention and in the present application to Genex Technologies, Inc.

II. Related Appeals and Interferences

There are no appeals or interferences related to the present application of which the Appellant is aware.

III. Status of Claims

Under the imposition of a previous Restriction Requirement, claims 1-31 and 40-59 were withdrawn from consideration. To expedite prosecution of this application, these claims have been cancelled without prejudice or disclaimer.

Further, in a previous office action claims 37-39 and 60-64 were also alleged to be drawn to nonelected species according to the previous Restriction Requirement, and were therefore withdrawn. Of these claims 60, 63 and 64 are an independent claim set and are not at issue in this appeal. Claims 37-39, 61, and 62 are still at issue due to their dependence on pending claims. Appellant will be entitled to rejoinder of any withdrawn dependent claims upon the allowance of any corresponding independent claims. MPEP § 821.04.

Thus, claims 32-36, 61, 62 and 65-73 are currently pending in the application and stand finally rejected. Accordingly, Appellant appeals from the final rejection of claims 32-36, 61, 62 and 65-73, which claims are presented in the Appendix.

IV. Status of Amendments

No amendments have been filed subsequent to the final Office Action of **January 27, 2010**, from which Appellant takes this appeal.

V. Summary of Claimed Subject Matter

Appellant's application discloses a method for performing high speed three dimensional imaging using a monochromatic sensor. More specifically, a camera configuration is disclosed having a monochromatic sensor that receives light patterns produced by a monochromatic light projector. A number of methods are disclosed for using the present camera configuration to produce, among other things, a red green blue (RGB) color image, a three dimensional image, multiple exposures in a single frame, and full coverage three-dimensional images. (*Appellant's specification, paragraph [0025]*)

Turning to the presently pending claim, Appellant's application claims the following.

32. A high speed 3D surface imaging camera comprising:

a light projector (100) for selectively illuminating an object (460) (*Appellant's specification, paragraph [0028]*), said light projector (100) being configured to project three sequential light beam projections having different colors and different spatially varying intensity patterns from said projector onto said object (460) (*Appellant's specification, paragraph [0036]*); and

an image sensor (400) configured to receive reflected light from said object (460) and to generate three separate color image data sets based on said three sequential, differently colored, variable intensity pattern light beam projections (*Appellant's specification, paragraph [0032]*), said three separate color image data sets providing said 3D image data of said object (460) (*Appellant's specification, paragraph [0036]*).

65. A 3D imaging camera comprising:

a light projector (100) for selectively illuminating an object (460) (*Appellant's specification, paragraph [0028]*), said light projector (100) being configured to project a number of sequential light beam projections having different wavelengths and different spatially varying intensity patterns from said projector (100) onto said object (460) (*Appellant's specification, paragraph [0036]*); and

an image sensor (400) configured to receive reflected light from said object (460) and to generate a number of separate image data sets based on said number of sequential light beam projections (*Appellant's specification, paragraph [0032]*), said separate image data sets providing said 3D image data of said object (460) (*Appellant's specification, paragraph [0036]*).

VI. Grounds of Rejection to be Reviewed on Appeal

The final Office Action raised the following grounds of rejection.

(1) Claims 32-36, 61, 62 and 65-72 were all rejected under 35 U.S.C. § 102(e) as anticipated by U.S. Patent App. Pub. No. 2003/0235335 to Yukhin et al. ("Yukhin").

(2) Claim 73 was rejected under 35 U.S.C. § 103(a) over the combined teachings of Yukhin and U.S. Patent No. 5,014,121 to Hasegawa et al. ("Hasegawa").

Accordingly, Appellant hereby requests review of these rejections in the present appeal.

VII. Argument

(1) Claims 32-36, 61, 62 and 65-72 are patentable over Yukhin:

Claim 32:

Independent claim 32 recites:

> A high speed 3D surface imaging camera comprising:
> a light projector for selectively illuminating an object, said light projector being configured to project ***three sequential light beam projections having different colors*** and different spatially varying intensity patterns from said projector onto said object; and
> an image sensor configured to receive reflected light from said object and to ***generate three separate color image data sets based on said three sequential, differently colored, variable intensity pattern light beam projections***, said three separate color image data sets providing said 3D image data of said object.

(Emphasis added).

In this regard, the Office Action cites to Yukhin at paragraphs 0054 and 0060-63. (Final Office Action, p. 7). According to the Action, Yukhin teaches "said light projector (401) being configured to project three sequential light beam projections having different colors (light source 510A-510N) and different spatially varying intensity patterns (SLMs 515A-515N)." (*Id.*). This is incorrect.

Yukhin actually teaches the following.

> Light sources 510A-510N may generate light beams. In at least one embodiment, one or more light source 510A-510N can generate light of a different spectral range, for example, ranges of the ultraviolet, visible and infra-red spectra of electromagnetic radiation. Thus, in one such embodiment, light from one to N spectral ranges may be projected on object 560 from the exemplary illuminating unit.

(Yukhin, paragraph 0062).

Thus, Yukhin teaches using radiation from different spectral ranges and does not teach or suggest the claimed light projector configured to project "three sequential light beam projections having different *colors*." (Claim 32) (emphasis added). Rather, Yukhin teaches

using a light source in each of the ultraviolet, visible and infra-red spectra, not three different colors as claimed.

In response to this argument, the final Office Action argues as follows. "Claim 32 does not read [that] the light beam projections each of a different color *within the visible spectrum*. Examiner analyzes the light source of Yukhin can generate light of different colors from different spectral ranges." (Final Office Action, p. 4) (emphasis in original). Appellant believes this is beyond the broadest reasonable construction of claim 32.

The word "color" is defined as follows. "▸ *noun*: the appearance of objects (or light sources) described in terms of a person's perception of their hue and lightness (or brightness) and saturation ▸ *noun*: a visual attribute of things that results from the light they emit or transmit or reflect." (http://www.onelook.com/?w=color&ls=a). Thus, is should be clear that when Appellant recites a projector outputting light beam projections of three different *colors*, that is three different wavelengths within the visible spectrum and not light from different spectral ranges as taught by Yukhin. For at least this reason, Yukhin cannot anticipate claim 32 or its dependent claims.

Moreover, Yukhin never teaches or suggests the claimed light projector that projects the light beams *sequentially*, i.e., "three sequential light beam projections having different colors." (Claim 32). Appellant would not think it necessary to define the word "sequential," but perhaps it is helpful given the response of the final Office Action. "Sequential" means "of, relating to, or arranged in a sequence." (http://www.merriam-webster.com/dictionary/sequential). A "sequence" is "a following of one thing after another in time." (http://www.onelook.com/?w=sequence&ls=a").

Thus, as should be clear from Appellant's specification and from the language of the claim, that claim 32 calls for a light projector that projects three light projections of three different colors in sequence, i.e., one after another in time. In the words of the claim itself, a light projector is recited "for selectively illuminating an object, said light projector being configured to project three *sequential* light beam projections having different colors and different spatially varying intensity patterns from said projector onto said object." (Claim 32) (emphasis added). This subject matter is clearly not in the cited prior art.

In response, the final Office Action argues as follows.

> Yukhin teaches the control unit 402 may also control temporal functions, such as the length of time or frequency of the illumination. The Examiner analyzes the limitation of temporal functions to mean limited or length of time. Yukhin teaches the structured illumination from the N sources is projected by an optical system, e.g., an afocal optical system, on the object's surface, distorted by a surface relief of the object and collected by the N photodetectors. The collected images are converted by corresponding electronic units to digital signals and preprocessed (Para 43). Yukhin teaches the signal processor 420 may control illumination unit 401 and detecting unit 405 via control units 402 and 406 (Para 56) Yukhin teaches the control unit 406 transmits timing and control signals to detecting unit 405. Detecting unit 405 may be positioned to receive primarily light transmitted from a neighboring illumination unit and reflected from the surface of an object in the area or transmitted from an opposing illumination unit and passing through the area (Para 58). Examiner analyzes this to mean the control unit 402 controls the timing of each illuminating unit 401 and control unit 406 controls the timing of detecting unit 405 to receive primarily light transmitted from a neighboring illumination unit 401. For the above reasons, the Examiner believes the Yukhin reference does teach the limitations of claims 32 and 65, and the rejection to the claim will be set forth below.

(Final Office Action, pp. 2 and 3).

Appellant submits that nowhere in this analysis does the Action come close to indentifying how or where Yukhin teaches or suggests the claimed light projector that projects three light projections of three different colors in sequence, i.e., one after another in time. There is no showing here that the cited prior art teaches or suggests the claimed light projector "for selectively illuminating an object, said light projector being configured to

project three *sequential* light beam projections having different colors and different spatially varying intensity patterns from said projector onto said object." (Claim 32)

Respectfully, to anticipate a claim, a reference must teach each and every element of the claim, and "the identical invention must be shown *in as complete detail as contained in the ... claim.*" MPEP 2131 citing *Verdegaal Bros. v. Union Oil Co. of California*, 814 F.2d 628, 2 USPQ2d 1051 (Fed. Cir. 1987) and *Richardson v. Suzuki Motor Co.*, 868 F.2d 1226, 9 USPQ2d 1913 (Fed. Cir. 1989) (emphasis added). Moreover, "[t]he prior art reference—in order to anticipate under 35 U.S.C. § 102—must not only disclose all elements of the claim within the four corners of the document, but must also disclose those elements 'arranged as in the claim.'" *NetMoneyIn v. Verisign*, (Fed. Cir. 2008) (quoting *Connell v. Sears, Roebuck & Co.*, 722 F.2d 1542 (Fed. Cir. 1983)).

In the present case, Yukhin clearly does not disclose the claimed invention with each and every claimed element in the same amount of detail or as arranged in the claim. Consequently, because Yukhin clearly fails to satisfy the requirements for anticipating claim 32, the rejection of claim 32 and its dependent claims should not be sustained.

Claim 65:

Claim 65 recites:

> A 3D imaging camera comprising:
> a light projector for selectively illuminating an object, said light projector being configured to project a number of ***sequential*** light beam projections having different wavelengths and different spatially varying intensity patterns from said projector onto said object; and

> an image sensor configured to receive reflected light from said object and to generate a number of separate image data sets based on said number of sequential light beam projections, said separate image data sets providing said 3D image data of said object.

(Emphasis added).

As noted above, Yukhin never teaches or suggests the claimed light projector that projects the light beams *sequentially*, i.e., "tsaid light projector being configured to project a number of ***sequential*** light beam projections having different wavelengths and different spatially varying intensity patterns from said projector onto said object." (Claim 65) (emphasis added). The Office Action fails to even address this point.

Respectfully, to anticipate a claim, a reference must teach each and every element of the claim, and "the identical invention must be shown *in as complete detail as contained in the ... claim*." MPEP 2131 citing *Verdegaal Bros. v. Union Oil Co. of California*, 814 F.2d 628, 2 USPQ2d 1051 (Fed. Cir. 1987) and *Richardson v. Suzuki Motor Co.*, 868 F.2d 1226, 9 USPQ2d 1913 (Fed. Cir. 1989) (emphasis added). Moreover, "[t]he prior art reference—in order to anticipate under 35 U.S.C. § 102—must not only disclose all elements of the claim within the four corners of the document, but must also disclose those elements 'arranged as in the claim.'" *NetMoneyIn v. Verisign*, (Fed. Cir. 2008) (quoting *Connell v. Sears, Roebuck & Co.*, 722 F.2d 1542 (Fed. Cir. 1983)).

In the present case, Yukhin clearly does not disclose the claimed invention with each and every claimed element in the same amount of detail or as arranged in the claim. Consequently, because Yukhin clearly fails to satisfy the requirements for anticipating claim 65, the rejection of claim 65 and its dependent claims should not be sustained.

Additionally, various dependent claims of the application recite subject matter that is further patentable over the cited prior art. Specific, non-exclusive examples follow.

Claim 34:

Claim 34 recites "wherein said plurality of CCD sensors comprises 3 CCD monochromatic sensors." However, as demonstrated above, Yukhin teaches light sources operating in three different spectral ranges, i.e., ultraviolet, visible and infrared. This clearly teaches away from the claimed "3 CCD monochromatic sensors" of claim 34. For at least this additional reason, the rejection of claim 34 should not be sustained.

Claim 35:

Claim 35 recites: "[t]he high speed 3D surface imaging camera of claim 32, further comprising a computing device communicatively coupled to said image sensor wherein said computing device is ***configured to combine said separate color image data sets into a composite Rainbow-type image of said object.*** (Emphasis added). In this regard, the current Office Action cites to Yukhin at paragraphs 0070-0075. (Final Office Action, p. 9). This paragraphs describe the processing of data from a number of photoregistrars.

[0074] As shown in FIG. 6, digital image data from each of the one or more photoregistrars is passed to at least one signal processor 660A-660N. Each signal processor 660A-660N recognizes and processes one version of distorted patterns, such as an aperiodic system of strips. The coding sequence for the pattern of structured illumination may depend on the pattern projected by SLM devices 515A-515N of FIG. 5. For instance, in a system utilizing aperiodic strips, a "1" may be generated when a line is present, and when a line is absent, a "0" may be produced. The output of this exemplary coding sequence is shown in FIGS. 7a and 7b. Consistent with the present invention, the system may, however, utilize other patterns or types of structured light, such as a grid pattern. In addition, other coding schemes for coding the distorted patterns may be utilized.

[0075] The resultant processed digital signal such as reconstructed 3D topology from signal processors 660A-660N may be accumulated in electronic unit 690. For example, processor 670 of electronic unit 690 may sum the signals received from each of signal processors 660A-660N to create a "overall" digital image. In addition to summarizing the binary signals, processor 670 may determine the coordinates values (X,Y) of the object's surface. As a result, each line (or strip) in the "overall" digital image may have a unique number in binary code. Based on the summarized codes, processor 670 can then calculate the distance, Z, and corresponding pairs of coordinates because distances between the strips forming structural illumination differ on the registered picture. Portal Recognition System

(Yukhin, paragraphs 0074-0075).

Appellant notes that the result described is an "overall" digital image. However, Yukhin never teaches or suggests the claimed "combin[ation of] said separate color image data sets into a composite Rainbow-type image of said object." (Emphasis added). Therefore, for at least this additional reason, the rejection of claim 35 should not be sustained.

Claim 61:

Claim 61 recites "a computing device communicatively coupled to said image sensor, wherein said computing device further comprises a mosaic means configured to combine said three separate color image data sets to form a multi-view 3D image of said object." As cited above, Yukhin does not teach or suggest mosaic means combining three separate color image data sets to form a 3D image of an object. Rather, Yukhin works on entirely different

principles. For at least this additional reason, the rejection of claim 61 should not be sustained.

Claim 62:

Claim 62 recites "wherein each of said 3 CCD monochromatic sensors comprise a matched narrow-band spectral filter disposed in front of said CCD sensor." According to the Action, this subject matter is taught by Yukhin in the form of a "beam splitter 615." (Final Office Action, p. 10). This is clearly incorrect.

Claim 62 recites three separate narrow-band spectral filters respectively disposed in front of three CCD monochromatic sensor. A beam splitter is not a narrow-band spectral filter. A single beam splitter is not three separate narrow-band spectral filters, as claimed. For at least this additional reason, the rejection of claim 62 should not be sustained.

(2) Claim 73 is patentable over Yukhin and Hasegawa:

Claim 73 recites: "The 3D imaging camera of claim 65, wherein said light projector is configured to project three sequential light beam projections each of a different color within the visible spectrum." In response, the final Office Action concedes that "Yukhin does not specifically teach light beam projections each of a different color within the visible spectrum." (Final Office Action, p. 15).

Accordingly, the Action cites to Hasegawa. As Appellant has noted previously on this record, Hasegawa teaches "an image pickup system with an illuminating device capable of sequentially irradiating three kinds of color lights different from each other onto an object, an objective lens system forming images of the object with the color lights, a solid-state image sensor receiving the images of the object, a signal processing device producing individual

color images of the object based on the solid-state image sensor, and a color dispersion device or a color separation device disposed in an optical path of light incident on the solid-state image sensor from the object." (Hasegawa, Abstract). Hasegawa further teaches that "image signals corresponding to the respective colors... are integrated together...to thereby be displayed in color on a screen of a color TV monitor 23." (Id, col. 4, line 67 to col. 5, line 9). In other words, Hasegawa *exclusively* teaches a method of producing a 2D image.

According to the final Office Action,

> Hasegawa shows in figure 4 the filter disc (8) is constructed in such a way that filters 8a, 8b and 8c having such spectral transmittances as will transmit there through only R light, only G light and only B light, respectively, are arranged at an equal interval from each other on a same circumference (Col. 5, line 65 - Col. 6, line 13). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have provided filter disk as taught by Hasegawa to the illuminating unit of Yukhin, to provide an image pickup device which eliminates degradation of the integrated color image brought about by chromatic aberration of the images for the respective colors (Col. 1, lines 65 - 68 of Hasegawa).

(Final Office Action, p. 15).

This position raises significant questions. First, why would one skilled in the art apply the teachings of Hasegawa for producing 2D images to the teachings of Yukhin? Second, Yukhin clearly teaches using radiation from different spectra, i.e., ultraviolet, infrared, etc. Why would one of skill in the art modify these teachings to include the color filters taught by Hasegawa?

In a recent decision, the Board of Patent Appeals and Interferences stated the following:

The Examiner's articulated reasoning . . . in the rejection must possess a rational underpinning to support the legal conclusion of obviousness. *In re Kahn*, 441 F.3d 977, 988 (Fed. Cir. 2006). The Supreme Court, reiterating this reasoning by citing *In re Kahn*, 441 F.3d at 988, stating that 'rejections on obviousness grounds cannot be sustained by mere

conclusory statements; instead, there must be some articulated reasoning with some rational underpinning to support the legal conclusion of obviousness.' *KSR* at 412.

Ex Parte Val Mandrusou, Application Serial No. 10/235,221, 2008 WL 2845083 (B.P.A.I. 2008).

Given this, it would seem clear that the rejection of claim 73 is based on a mere conclusory statement, cited above, with no rational underpinning supporting the legal conclusion of obviousness. There is no reason to conclude that one of skill in the art would not have found it obvious to combine the disparate teachings of Yukhin and Hasegawa in a manner approximating Appellant's disclosure and claims. For at least these reasons, no *prima facie* case of obviousness has been made as to claim 73, and thus the rejection of claim 73 should not be sustained.

In view of the foregoing, it is submitted that the final rejection of the pending claims is improper and should not be sustained. Therefore, a reversal of the Rejection of **January 27, 2010** is respectfully requested.

Respectfully submitted,

DATE: June 24, 2010

/Steven L. Nichols/
Steven L. Nichols
Registration No. 40,326

STEVEN L. NICHOLS
Director, Intellectual Property
Practice Group
VANCOTT
36 SOUTH STATE STREET,
SUITE 1900
SALT LAKE CITY, UT 84111
P 801.237.0251

VIII. CLAIMS APPENDIX

1-31. (cancelled)

32. (previously presented) A high speed 3D surface imaging camera comprising:

a light projector for selectively illuminating an object, said light projector being configured to project three sequential light beam projections having different colors and different spatially varying intensity patterns from said projector onto said object; and

an image sensor configured to receive reflected light from said object and to generate three separate color image data sets based on said three sequential, differently colored, variable intensity pattern light beam projections, said three separate color image data sets providing said 3D image data of said object.

33. (original) The high speed 3D surface imaging camera of claim 32, wherein said image sensor comprises a plurality of charge-coupled device (CCD) sensors.

34. (previously presented) The high speed 3D surface imaging camera of claim 33, wherein said plurality of CCD sensors comprises 3 CCD monochromatic sensors.

35. (original) The high speed 3D surface imaging camera of claim 32, further comprising a computing device communicatively coupled to said image sensor wherein said computing device is configured to combine said separate color image data sets into a composite Rainbow-type image of said object.

36. (original) The high speed 3D surface image camera of claim 32, wherein said means for projecting sequential color projections comprises one of a rotatable color wheel, a deformable mirror, or a sequential RGB light emitting diode array.

37. (withdrawn) The high speed 3D surface image camera of claim 36, further comprising:

an array of closely spaced light emitting diodes configured to generate a high density projection pattern; and

driver electronics communicatively coupled to said array of closely spaced light emitting diodes, wherein said driver electronics are configured to synchronize a projection pattern of light from said light emitting diodes with said image sensor to achieve optical quality performance.

38. (withdrawn) The high speed 3D surface image camera of claim 37, wherein said array of closely spaced light emitting diodes is further configured to project said high density projection pattern for a time period not detectible by human eyes.

39. (withdrawn) The high speed 3D surface image camera of claim 38, wherein said time period not detectible by human eyes comprises less than 1/1000 of a second.

40-59. (cancelled)

60. (withdrawn)

61. (withdrawn) The high speed 3D surface imaging camera of claim 32, further comprising a computing device communicatively coupled to said image sensor, wherein said computing device further comprises a mosaic means configured to combine said three separate color image data sets to form a multi-view 3D image of said object.

62. (withdrawn) The high speed 3D surface imaging camera of claim 34, wherein each of said 3 CCD monochromatic sensors comprise a matched narrow-band spectral filter disposed in front of said CCD sensor.

63-64. (withdrawn)

65. (previously presented) A 3D imaging camera comprising:

a light projector for selectively illuminating an object, said light projector being configured to project a number of sequential light beam projections having different wavelengths and different spatially varying intensity patterns from said projector onto said object; and

an image sensor configured to receive reflected light from said object and to generate a number of separate image data sets based on said number of sequential light beam projections, said separate image data sets providing said 3D image data of said object.

66. (previously presented) The 3D imaging camera of claim 65, in which said light projector is further configured to project light beams in the near infrared spectrum, and said image sensor is further configured to receive light in the near infrared spectrum.

67. (previously presented) The 3D imaging camera of claim 65, in which said image sensor is configured to receive said number of sequential light beam projections sequentially within a single frame cycle.

68 (previously presented) The 3D imaging camera of claim 65, in which said image sensor comprises a number of charge-coupled device (CCD) sensors.

69 (previously presented) The 3D imaging camera of claim 65, in which said CCD sensors comprises monochromatic CCD sensors.

70. (previously presented) The 3D imaging camera of claim 65, further comprising a computing device communicatively coupled to said image sensor in which said computing device is configured to combine said separate image data sets into a composite Rainbow-type image of said object.

71. (previously presented) The 3D imaging camera of claim 65, in which each of said charge-coupled device (CCD) sensors comprise a matched narrow-band spectral filter disposed in front of said charge-coupled device (CCD) sensor.

72 (previously presented) The 3D imaging camera of claim 65, in which each of said number of sequential light beam projections projects light in a unique spectrum band corresponding to one of said charge-coupled device (CCD) sensors.

73. (previously presented)The 3D imaging camera of claim 65, wherein said light projector is configured to project three sequential light beam projections each of a different color within the visible spectrum.

IX. Evidence Appendix

None

X. Related Proceedings Appendix

None